Laboratory Analysis for Arsenic in Drinking Water Samples

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The EPA has established maximum contaminant levels (MCLs) for many inorganics found in drinking water to protect the health of the American population. Some of these chemicals occur naturally in ground and surface waters, while some are the result of spills and mishandling of industrial waste. Some chemicals, such as arsenic, have been under close scrutiny by the EPA and, in 2001, the MCL was lowered from 50 to 10 parts per billion (ppb). Municipalities have until 2006 to take the necessary steps to meet these requirements in order to be in compliance. Municipal water treatment plants can remove harmful amounts of inorganics either by aeration or by adding chlorine to the water. Chlorination is faster but more expensive. Lower acceptable limits of arsenic are forcing some municipalities to convert to alternate methods of purification. Changing from one purification process to another can alter the chemistry of the treated water. These changes may cause dissolution of contaminants from scale and deposits within drinking water distribution pipes, thereby creating additional problems.

Ongoing studies, lasting three months at a time, are conducted at the EPA laboratories using a small-scale water treatment plant to determine the effects of aeration compared with chlorination on copper, lead, iron, and brass plumbing materials.

These studies require analytical support to completely characterize the water chemistry during these testing phases. One analytical technique determines the concentration of 21 different elements simultaneously in samples of water. This testing is conducted on an inductively coupled argon plasma atomic emission spectrometer (ICAP-AES). This instrument converts the water sample to an aerosol, super heats the aerosol to reduce the inorganic components to their elemental composition, then thermally excites the electrons of the elements present in the sample. The electrons return to their normal state by emitting light characteristic of the element. Each element has a set of distinct wavelengths or “colors.” This light is focused on a grating or prism to separate these wavelengths. This light is then directed toward detectors located to receive light specific for each element. These light measurements are then converted to concentration.

These measurements are charted over the three-month study period and reveal changes in the amounts of chemicals found in the water during that time. The results of this testing reveal the effects of the various changes and provide guidance for municipal water treatment plants throughout the United States.